

# **DESALINATION TASK FORCE**

## Convener and Chair

California Department of Water Resources

## Co-Chairs

State Water Resources Control Board

California Energy Resources Conservation and Development Commission

California Coastal Commission

California Department of Health Services

# **DRAFT**

## **Desalination Issues Assessment Report**

Prepared by the Center for Collaborative Policy,  
California State University, Sacramento

May 21, 2003

**DESALINATION TASK FORCE**  
Convened by the Department of Water Resources

**Draft Issues Assessment Report**

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# DESALINATION TASK FORCE

## Draft Issues Assessment Report

### Executive Summary

**Introduction.** In September 2002, Governor Davis signed into law AB 2717, designating the Department of Water Resources (DWR) to establish a Desalination Task Force to “make recommendations related to potential opportunities for the use of seawater and brackish water desalination.” No later than July 1, 2004, DWR is to report to the legislature on potential opportunities for the use of seawater and brackish water desalination in California; impediments to the use of desalination technology; and what role, if any, the State should play in furthering the use of desalination.

**Convening the Task Force.** Joining DWR as Co-Chairs of the Task Force are the State Water Resources Control Board, California Energy Resources Conservation and Development Commission, California Coastal Commission, and California Department of Health Services. Seventeen other agencies and interest groups were identified by AB 2717 to comprise the Task Force. Representatives of five additional organizations with desalination regulatory responsibilities have been added to the Task Force: the Bay Conservation and Development Commission (BCDC); California Department of Fish and Game; city and county governments; and, the National Oceanic and Atmospheric Administration (NOAA). The Center for Collaborative Policy (CCP), a program of California State University, Sacramento, has been engaged to conduct this Issues Assessment and thereafter, assist in managing the Task Force collaborative process.

**General Areas of Agreement.** As California’s population increases, most people are concerned about the adequacy of existing water supplies and usage patterns. New supplies of water will likely be needed from a variety of sources, including conservation, recycling and potentially desalination. Although a wide range of perspectives are held about desalination, general agreement exists on several issues that provide the foundation for the work of the Task Force. These include:

- 1) Desalination, at least under certain conditions or in comparison to alternatives, shows promise as a water supply source for California;
- 2) Energy consumption and associated costs are major concerns;
- 3) Facilities should be operated in an environmentally sensitive manner; and
- 4) Clarity and coordination of permitting and regulatory guidelines are needed.

**Anticipated Outcomes.** The work of the Task Force is being divided into two phases. The first phase will focus on issues identification, making sure all the key issues associated with desalination in California are clearly identified and fully understood. The second phase will then focus on developing policy guidelines and solutions to the issues identified in the first phase.

**Collaborative Process.** The first phase of the Task Force’s work is scheduled to begin in May 2003 and be completed by September 2003. The first and last meetings will be half-day meetings in Sacramento. The three intermediate meetings will be one and one-half day working sessions, convened in association with public workshops. These meetings will be held in the Los Angeles, San Francisco and Monterey areas, respectively. Individuals and organizations with expertise in the topics being addressed will be invited to join the Task Force for the three working sessions.

# **DESALINATION TASK FORCE DRAFT ISSUES ASSESSMENT REPORT**

## **1. Introduction**

In September 2002, Governor Davis signed into law AB 2717 (see Appendix A), designating the Department of Water Resources (DWR) to establish a Water Desalination Task Force to “make recommendations related to potential opportunities for the use of seawater and brackish water desalination.” Furthermore, AB 2717 requires that no later than July 1, 2004, DWR will report to the legislature on:

- 1) potential opportunities for the use of seawater and brackish water desalination in California;
- 2) impediments to the use of desalination technology; and
- 3) what role, if any, the State should play in furthering the use of desalination.

The legislation is also built on the declaration that: “There is clear public interest in ensuring that land and facilities are available for cost-effective seawater desalination.” As such, the Task Force is “to provide assistance to persons or entities seeking to construct desalination facilities.”

Joining DWR in Co-Chairing the Task Force are the State Water Resources Control Board, California Energy Resource and Conservation Commission, California Coastal Commission and California Department of Health Services. Seventeen other agencies and interest groups were identified by AB 2717 to comprise the Task Force, as identified in Appendix A. Representatives of five other organizations with regulatory responsibilities associated with desalination have been added to the Task Force: the Bay Conservation and Development Commission (BCDC); California Department of Fish and Game; and city and county governments; and, the National Oceanic and Atmospheric Administration (NOAA).

In establishing the Task Force, AB 2717 identifies a series of issues that should be addressed. These represent the scope of activity for the Task Force, which can be consolidated into three major areas of inquiry:

- 1) evaluating the current regulatory framework, identifying obstacles, constraints and methods to creating a more efficient siting and permitting system; evaluating the role the State should play in furthering the use of desalination technology;
- 2) evaluating energy and water supply options (existing and alternatives), energy consumption and the economic costs of desalination, in

- relationship to desalination technology; evaluating the impacts of desalination on State revenues; and
- 3) evaluating the environmental impacts of brine disposal, energy use and large-scale ocean water desalination, ensuring water quality standards are met; identifying impediments or constraints, other than water rights, to increasing the use of desalination.

The legislation refers to both “seawater and brackish water desalination” and “the use of desalinated water both in coastal and inland regions.” Although the primary focus is often on ocean desalination, the Task Force is to explore the broader applications of desalination throughout the State. Desalination facilities associated with estuarine waters are also an important consideration. Appendix B provides an overview of recent activities associated with desalination in California, including lists of existing and proposed ocean desalination facilities.

The Center for Collaborative Policy (CCP), a program of California State University, Sacramento, has been engaged by DWR to conduct this issues assessment and prepare this report. In addition, CCP is responsible for designing and managing the Task Force collaborative process as an independent party accountable to all members of the Task Force.

## **2. Overview of Task Force Collaborative Process**

Based on the current availability of \$100,000, the work of the Desalination Task Force will be divided into two phases. Using existing funds, the first phase will focus on identifying and thoroughly understanding the key issues, constraints and opportunities associated with the use of desalination in California. The second phase, if adequate funding is made available, will focus on developing policy guidelines and solutions to the issues raised in phase one.

As part of its work in identifying impediments and constraints, the Task Force will consider the purpose of those constraints and the safeguards those constraints may provide. For example, studies required to determine a desalination facility’s effect on marine biology may be considered a constraint to desalination, but those studies are also meant to ensure that coastal resources are adequately protected. Constraints and opportunities need to be fully defined.

Several working papers are planned during the first phase to detail the key issues associated with desalination as the basis for further inquiry by the Task Force. In addition, a listing of key research initiatives related to desalination in California will be compiled to provide Task Force members with a clear sense of what is being done to more thoroughly understand the impacts of

desalination. Updates on legislative initiatives and the work of other groups addressing desalination issues will also be compiled and shared with the Task Force. A summary and analysis of existing desalination regulatory requirements will also be provided.

As currently envisioned, the Task Force will meet five times during the first phase of its work. The first and last meetings will be one-half day sessions, and the other three “working sessions” will be one-and-one-half days. These working sessions will be held in conjunction with public workshops located at different locations throughout the state. The working sessions will also include participants from organizations not on the Task Force in order to engage individuals and organizations with valuable desalination expertise and experience, and to make sure all key interests are represented.

Phase one of the Task Force’s work will begin in late May and be completed by late September 2003. During the later stages of the first phase it will be ascertained whether and when a second phase will be conducted to focus in greater detail on policy guidelines and solutions to prevailing issues.

A brief overview of each meeting proposed as part of phase one follows:

#### Task Force Meeting 1

*Purpose:* introduce Task Force members; discuss the scope and objectives of phase one; discuss the process for completing the work of the Task Force; discuss driving forces behind increased interest in desalination; highlight current legislative, policy and research initiatives related to desalination in California; review and comment on the Issues Assessment Report; identify range of issues to be addressed by the Task Force; discuss tasks to be completed in preparation for the next meeting, including working papers and presentations.

*Timeframe:* May 29, 2003; 10:00 a.m. - 3:00 p.m.

*Location:* Sacramento

#### Task Force Meeting 2

*Purpose:* discuss issues and interests related to facility siting, feedwater intake and brine discharge, including ecological impacts and mitigation associated with different options; identify potential constraints and solutions (as time allows); discuss possible role of the State in addressing both the constraints and solutions; discuss tasks to be completed in preparation for the next meeting, including working papers and presentations; convene first of three public workshops.

*Timeframe:* late June 2003; first day, 1:00 p.m. - 5:00 p.m., public workshop 6:00 p.m. - 9:00 p.m., second day, 8:30 a.m. - 12:30 p.m.

*Location:* Los Angeles area

#### Task Force Meeting 3

*Purpose:* discuss issues and interests related to energy needs, energy sources, economics and membrane technology, including viable energy options and alternatives; identify potential constraints and solutions (as time allows); discuss possible role of the State in addressing both the constraints and solutions; discuss tasks to be completed in preparation for the next meeting, including working papers and presentations; begin discussion of approaches to resolving outstanding issues and developing policy guidelines; convene second public workshop.

*Timeframe:* late July 2003; first day, 1:00 p.m. - 5:00 p.m., public workshop 6:00 p.m. - 9:00 p.m., second day, 8:30 a.m. - 12:30 p.m.

*Location:* San Francisco area

#### Task Force Meeting 4

*Purpose:* discuss issues and interests related to planning and regulatory requirements, including growth inducement and improved permitting efficiency; identify potential constraints and solutions (as time allows); discuss possible role of the State in addressing both the constraints and solutions; discuss tasks to be completed in preparation for the next meeting, including summary of constraints and potential solutions; continue discussion of approaches to resolving outstanding issues and developing policy guidelines; convene third public workshop.

*Timeframe:* late August 2003; first day - 1:00 p.m. - 5:00 p.m., public workshop 6:00 p.m. - 9:00 p.m., second day - 8:30 a.m. - 12:30 p.m.

*Location:* Monterey area

#### Task Force Meeting 5

*Purpose:* review summary of identified constraints and potential solutions, and possible role of the state in desalination, based on public workshops and previous Task Force meetings; discuss and make recommendations concerning how to proceed with addressing outstanding issues and developing policy guidelines; identify and discuss next steps.

*Timeframe:* half day meeting in late September 2003

*Location:* Sacramento

Meetings will be facilitated by a CCP senior collaborative policy specialist, and meeting summaries will be prepared after each meeting to be distributed

to all Task Force members and participants. Meeting protocols will be approved by the Task Force at its first meeting to help guide the process.

### **3. Summary of Key Interests and Issues Concerning Desalination**

As the basis of this Issues Assessment, representatives from more than forty agencies and organizations were interviewed by CCP to obtain their perspectives on desalination and the Task Force. The list of organizations and individuals contacted as part of this assessment are included as Appendix C.

This section highlights the key interests, issues and perspectives expressed during interviews, providing a preview of the issues that will emerge during the course of the Task Force's work. It also contributes to a broader understanding of the interests held by various individuals and organizations throughout the State and of the potential opportunities and constraints associated with desalination in California.

Although this summary portrays the wide range of perspectives held about desalination, several general areas of agreement are noteworthy. There are at least four overarching concepts on which there is broad agreement:

- 1) Desalination, at least under certain conditions and/or in comparison to alternatives, shows promise as a water supply source for California;
- 2) Energy consumption and associated costs are major concerns which need to be addressed;
- 3) Desalination facilities should be located and operated in an environmentally sensitive manner; and
- 4) Clarity and coordination of permitting and regulatory guidelines are needed.

Most also acknowledge the driving force behind the expanded use of desalination is interest in maintaining the expected level of water reliability for both citizens and the economy. A more detailed list of comments, by general topic, is contained in Appendix D to augment this synopsis.

**A. Task Force Scope and Objectives.** Numerous comments were made about how desalination, and its related issues, should be addressed by the Task Force. Some suggest the Task Force needs to focus and agree on its objectives, clarifying what the State should manage towards concerning desalination. Is it to promote desalination wherever feasible, reduce pressure on the Bay/Delta water supply, reduce transfers from North to South, etc? Others stress the need to consider desalination on a case-by-case basis,



rather than generically. Still others are skeptical that desalination can be conducted on a large scale until the costs are further reduced and environmental concerns are addressed.

Many believe it is essential to put all the key issues on the table. Otherwise, the absence of discussion and agreement on major issues will likely impede progress on desalination in the future. Others are concerned about sidetracking progress of the Task Force if too many issues are addressed. Other major considerations cited include meeting the requirements of the Coastal Act and Public Trust Doctrine, informing DWR in developing Proposition 50 guidelines for funding desalination projects, and contributing to current efforts to update the California State Water Plan.

**B. Permitting and Regulatory Issues.** With more than 20 local, State and federal permits potentially required for a desalination facility, many believe more coordination is necessary to make the permitting process less cumbersome. Others are concerned that permitting efficiency should not occur at the cost of appropriate safeguards. Appendix E provides a summary of some of the major permits required to construct and operate a desalination facility.

Some encourage the development of general principles that can be adopted by all agencies with responsibilities for permitting desalination facilities. Likewise, many see the need for making the permitting process more efficient and practical. Some expressed the need to deal with water rights issues related to desalination. Additionally, some identified the need to have bay, coastal and marine waters designated in Basin Plans as a drinking water supply.

The issue of using private entities or public/private partnerships to build and operate desalination facilities has been raised in the context of using public funds for public water supplies. The question has also been raised as to whether desalination should be used for private developments. A growing concern exists about whether private entities that are subject to, or covered by, international trade agreements may be exempt from all or some state and local regulations.

**C. Energy Issues.** Almost universally, those interviewed cited the energy required for desalination as a major issue of concern. Some believe the energy issues associated with desalination can best be solved by co-locating desalination facilities with coastal power plants and acquiring energy from sources other than the grid. Others are concerned about tying desalination too closely to coastal power plants using once-through ocean water cooling systems due to ongoing efforts to minimize or eliminate these facilities. Linking desalination facilities with existing power plants will be a crucial topic of discussion.

Based on the interviews, this is an issue where a significant amount of technical support might prove helpful. Suggestions for additional information include: 1) exploring ways to reduce energy costs; 2) evaluating methods of energy recovery; 3) identifying sources of new and renewable energy sources that might have application to desalination facilities; 4) evaluating future trends in energy production; and 5) analyzing the energy consumption (and related issues such as costs and air quality) associated with desalination versus pumping water from other regions.

**D. Economic Issues.** In addition to the costs of energy required for operating desalination facilities, other cost issues associated with desalination include environmental costs and benefits, compliance costs, and technical studies or research costs. Almost everyone acknowledges that coastal desalination was not considered a viable option, financially, until two factors recently began to merge: the increased cost of water (to store or transport water long distances) and the reduced cost of desalination (caused by improved, longer lasting membranes requiring less energy). Even with this combination of factors, most still remain concerned about the costs of desalination and believe more attention should be given to find ways to reduce costs.

Several also voiced the concern that without subsidies, desalination on its own merits is still not financially viable. Many believe a realistic, independent evaluation of cost assumptions, and total costs of desalination, is needed. Interest also exists in developing incentives and strategies for financial efficiencies. Additionally, ways to reduce the costs associated with inland desalting projects and brine disposal are needed.

**E. Planning and Growth Issues.** The most critical planning issue raised by many of those interviewed is the potential growth inducing impacts of desalination. As such, those who hold this perspective believe growth inducement associated with desalination must be addressed by the Task Force. On the other hand, some believe this is outside the scope of the Task Force since growth projections are a given, and not determined by the organizations responsible for water supply.

The Coastal Commission has noted, as an essential component of the Coastal Act and California Environmental Quality Act processes, more than twenty years of experience exists related to dealing with growth in permitting processes. As such, it has been suggested that the growth inducing impacts of desalination be considered in the context of existing regulatory and permitting processes, benefiting from the long track record in dealing with growth inducement. Some suggest the main focus should be clarifying the steps necessary to comply with the existing regulatory requirements concerning growth inducement.

Another emerging issue is who should be involved in planning desalination facilities. Water purveyors have taken the lead in many instances, but some local governments (cities and counties) also feel they should play a major role in planning and developing desalination facilities.

**F. Siting Issues.** Siting is an issue several of those interviewed believe should be a critical aspect of the Task Force's work. Siting involves not only the location of the desalination facility, but also the source of water (e.g., wells, ocean water) and associated entrainment and water quality issues, as well as the impacts of the outfall. Some suggest this is why case-by-case analyses of desalination facilities are needed, since local siting issues affect energy and cost along with environmental acceptability. Land use compatibility is also another issue of concern cited, along with public access and aesthetics. Some believe these issues will have a large impact on public perceptions associated with desalination and its desirability on a localized scale. Inter-jurisdictional issues related to siting facilities also need to be addressed.

**G. Entrainment Issues.** Of the environmental issues mentioned in interviews, entrainment is one of the major concerns associated with ocean water desalination. Some of those interviewed suggest if desalination is too closely linked with once-through power plant cooling systems, the historic environmental concerns with power plant entrainment might be a liability for desalination. The primary entrainment issues involve the loss of individual marine organisms as well as biodiversity. Many believe a more thorough understanding and assessment of the ecological impacts associated with entrainment is needed, while others believe enough is known to establish policy guidelines. Some believe more attention needs to be given to developing solutions to mitigate the impacts of entrainment.

**H. Distribution and Outfall Issues.** The major environmental concern related to outfalls is brine disposal and effluent impacts. Nearly everyone interviewed cited brine disposal as a key issue. Most believe, however, this is an issue that can be mitigated under most circumstances. Those who remain concerned cite not just the increased salinity but also the concentration of metals and other elements that may contribute to its toxicity. The type and location of brine discharges also was noted as a concern, linked to offshore substrate. Many also suggest opportunities for mixing brine with other waste streams should be explored, some of which might result in environmental benefits. Potential impacts associated with introducing desalinated water into distribution systems were also noted.

While this summary presents information in distinct categories for organizational purposes, it is clear many of the issues overlap or are integrally related to each other. Most of those interviewed express some degree of

enthusiasm for the potential of desalination, particularly in comparison to the impact of tapping other sources of water. Yet many expressed concern that since much is unknown the State should proceed cautiously. For desalination to be widely embraced, they assert it is necessary to first build public trust.

#### 4. Potential Outcomes from the Task Force

Most of those interviewed as part of this assessment acknowledge new sources of water are needed for California's future given current growth projections, potentially unreliable access to shared water resources, the prospects of long-term drought and the increasing demands placed on existing water resources. Most acknowledge both ocean and brackish desalination are largely untapped resources that should be further explored for their potential to meet these long-term demands. Some are ready to move forward immediately and work through the issues as they are encountered. Others suggest various issues must be addressed before desalination will be widely embraced (e.g., permitting uncertainties, ecosystem impacts, growth inducement).

In light of the many perspectives highlighted, support was expressed for several desired outcomes from the Task Force, primarily revolving around three themes:

- 1) **Recommendations for coordinating planning, permitting and regulatory requirements.** Potential products could include: a guidebook consolidating planning, permitting and regulatory requirements and processes; strategies for improving coordination among governmental agencies, including specific approaches such as Memorandums of Understanding; strategies for making permitting processes more efficient, such as uniform protocols for permit information, as required for various permits; guidelines for complying with growth inducement regulatory requirements.
- 2) **Recommendations concerning energy options and opportunities for minimizing energy costs.** Potential products could include: a survey and evaluation of all potential energy sources for desalination, with a view towards long-term energy trends; a comparative analysis of relative costs and benefits (e.g., economics, water and air quality) of energy usage associated with desalination versus other water supplies.
- 3) **Recommendations addressing the key environmental, water resources and land use issues.** Potential products could include: the development of an environmental "checklist" of safeguards pertaining to desalination facilities, their water sources (including entrainment),

and outfall locations; a checklist of and guidance on local land use compatibility and related planning issues.

Given the phased approach to the Task Force, however, these recommendations would be developed in phase two after the major issues have been clarified and prioritized in phase one. Numerous other outcomes are likely, as identified by the Task Force, consistent with the enabling legislation. This summary simply highlights some of the potential outcomes consistently mentioned by those interviewed. Many also speak of outcomes that assure and maximize public benefits, and create sustainable desalination operations in light of energy, cost and environmental considerations.

## **5. Next Steps**

The next major step towards initiating the Task Force is for the DWR to formally invite Task Force members. This should occur by the middle of May, in anticipation of the first meeting of the Task Force on May 29, 2003 in Sacramento. Prior to the first meeting, each Task Force member will receive a copy of this second Draft Issues Assessment Report. Task Force members will also receive a draft agenda for the first meeting, draft meeting protocols, and a list of Task Force members with their contact information.

## Appendix A: AB 2717

BILL NUMBER: AB 2717 CHAPTERED  
BILL TEXT

CHAPTER 957  
PASSED THE ASSEMBLY AUGUST 29, 2002  
PASSED THE SENATE AUGUST 28, 2002  
AMENDED IN SENATE AUGUST 26, 2002  
AMENDED IN SENATE AUGUST 22, 2002  
AMENDED IN SENATE AUGUST 5, 2002  
AMENDED IN SENATE JUNE 12, 2002

INTRODUCED BY: Assembly Member Hertzberg

FEBRUARY 22, 2002

An act to add Section 12949.6 to the Water Code, relating to water, and making an appropriation therefor.

(Approved by Governor September 26, 2002. Filed with Secretary of State September 27, 2002.)

I am signing Assembly Bill 2717, however, I am reducing the appropriation from the Renewable Resources Investment Fund to \$100,000.

This bill would require the Department of Water Resources to convene a Water Desalination task force to make recommendations related to potential opportunities for the use of seawater and brackish water desalination. The revenues from the Renewable Resources Investment Fund are below projections and the fund is expected to have a significant shortfall this year. At a time when the state is dealing with a \$24 billion shortfall, any available funds should be used for on-going environmental activities and programs now supported by the General Fund that would otherwise be reduced or eliminated.

Studying the potential opportunities and impediments for the use of water desalination is an important step toward helping the state meet its water needs. Therefore, I am directing the Department of Water Resources to explore funding partnerships with interested local and private entities to accomplish this goal.

GRAY DAVIS, Governor

### LEGISLATIVE COUNSEL'S DIGEST

AB 2717, Hertzberg. Water: desalination: report.

(1) The Cobey-Porter Saline Water Conversion Law authorizes the Department of Water Resources, either independently or in cooperation with public or private entities to conduct a program of investigation, study, and evaluation in the field of saline water conversion, to provide assistance to persons or entities seeking to construct desalination facilities, and after submission of a written report and upon appropriation from the Legislature, to finance, construct, and operate saline water conversion facilities.

This bill would require the department, not later than July 1, 2004, to report to the Legislature, on potential opportunities and impediments for using seawater and brackish water desalination, and to examine what role, if any, the state should play in furthering the use of desalination technology. The bill would require the department to convene a Water Desalination Task Force, comprised of

representatives from listed agencies and interest groups, to advise the department in carrying out these duties and in making recommendations to the Legislature.

(2) Under existing law, the Bosco-Keene Renewable Resources Investment Fund is established for certain purposes. This bill would appropriate \$600,000 from the Bosco-Keene Renewable Resources Investment Fund to the department for the purpose of establishing the Water Desalination Task Force and preparing the report required by the bill.

Appropriation: yes.

THE PEOPLE OF THE STATE OF CALIFORNIA DO ENACT AS FOLLOWS:

SECTION 1. The Legislature finds and declares as follows:

(a) There is a clear public interest in ensuring that land and facilities are available for cost-effective seawater desalination.

(b) Recent advances in technology could make seawater desalination a more attractive option for increasing available water supplies.

(c) Additional information is necessary to assess the potential opportunities for seawater desalination in California.

(d) The activities of a water desalination task force are consistent with those activities for which the moneys in the Bosco-Keene Renewable Resources Investment Fund may be used pursuant to Section 34000 of the Public Resources Code.

SEC. 2. Section 12949.6 is added to the Water Code, to read:

12949.6. (a) Not later than July 1, 2004, the Department of Water Resources shall report to the Legislature on potential opportunities for the use of seawater and brackish water desalination in California. The report shall evaluate impediments to the use of desalination technology and shall examine what role, if any, the state should play in furthering the use of desalination in California.

(b) The department shall convene a task force, to be known as the Water Desalination Task Force, to advise the department in implementation of subdivision (a), including making recommendations to the Legislature regarding the following:

(1) The need for research, development and demonstration projects for more cost effective and technologically efficient desalination processes.

(2) The environmental impacts of brine disposal, energy use related to desalination, and large-scale ocean water desalination.

(3) An evaluation of the current regulatory framework of state and local rules, regulations, ordinances, and permits to identify the obstacles and methods to creating an efficient siting and permitting system.

(4) Determining a relationship between existing electricity generation facilities and potential desalination facilities, including an examination of issues related to the amounts of electricity required to maintain a desalination facility.

(5) Ensuring desalinated water meets state water quality standards.

(6) Impediments or constraints, other than water rights, to increasing the use of desalinated water both in coastal and inland regions.

(7) The economic impact and potential impacts of the desalination industry on state revenues.

(8) The role that the state should play in furthering the use of desalination technology in California.

(9) An evaluation of a potential relationship between desalination technology and alternative energy sources, including photovoltaic energy and desalination.

(c) (1) The task force shall be convened by the department and be comprised of one representative from each of the following agencies:

(A) The department.

(B) The California Coastal Commission.

(C) The State Energy Resources Conservation and Development Commission.

- (D) The California Environmental Protection Agency.
- (E) The State Department of Health Services.
- (F) The Resources Agency.
- (G) The State Water Resources Control Board.
- (H) The CALFED Bay-Delta Program.
- (I) The Department of Food and Agriculture.
- (J) The University of California.
- (K) The United States Department of Interior, if that agency wishes to participate.

(2) The task force shall also include, as determined by the department, one representative from a recognized environmental advocacy group, one representative from a consumer advocacy group, one representative of local agency health officers, one representative of a municipal water supply agency, one representative of urban water wholesalers, one representative from a regional water control board, one representative from a groundwater management entity, one representative of water districts, one representative from a nonprofit association of public and private members created to further the use of desalinated water, one representative of land development, and one representative of industrial interests.

(d) The sum of \$600,000 is hereby appropriated from the Bosco-Keene Renewable Resources Investment Fund to the department for the purpose of establishing the task force and preparing the report required in subdivision (a).

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## **Appendix B: Overview of Recent Activities and Initiatives Related to Desalination in California**

In large part, reconsideration of ocean desalination in California, and elsewhere, has been spurred by the development of filter membranes requiring much less energy, making the cost of producing desalinated water more competitive with other sources of water. In concert with the increasing costs of pumping water, the implications of extended drought, and regional water supply planning involving other states and joint resources, ocean desalination is gaining momentum.

On the other hand, desalting brackish groundwater at inland and near-coastal locations has been expanding for some time. The key issue in reclaiming even more saline groundwater as a water supply is finding acceptable methods for disposing of the brine. Reclaiming irrigation drainage is also receiving increased attention but again brine disposal is the key to expanding this application. It is clear that desalination is not only of interest to coastal urban areas, but also inland urban and agricultural areas.

Three other applications of desalination processes are also under consideration in California: desalination of wastewater, desalination efforts associated with stabilizing the Salton Sea, and clean up of toxic ground water contamination. While these latter three may be outside the primary scope of the Task Force, they may be addressed as the longer-term applications of desalination are considered.

Currently, there are only a few, relatively small ocean desalination facilities in operation. But many cities, large and small, up and down the California coast are seriously considering and planning desalination facilities. To date, about one dozen existing desalination facilities have been identified along the coast, and about 20 are in various stages of planning. These are summarized in Tables B-1 and B-2, respectively.

In addition to Task Force, numerous other initiatives and activities related to desalination are occurring in California. The Monterey Bay National Marine Sanctuary has established a multi-stakeholder Desalination Working Group. It has met three times and plans a fourth meeting to complete its recommendations related to desalination facilities within the Sanctuary.

In Southern California, five water districts have formed the U. S. Desalination Coalition. Partners in this effort include the Los Angeles Department of Water and Power, Municipal Water District of Orange County, Metropolitan Water District of Southern California, San Diego County Water Authority and the West Basin Municipal Water District. The purpose of the Coalition is to seek greater support for desalination at the national level.

New legislative initiatives concerning desalination are being considered in the California State legislature as well. On February 7, 2003, Assemblyman Kehoe introduced AB 314, Desalination, which declares "it is the policy of the State to facilitate development of desalination projects." On February 19, 2003, Senator Alpert introduced SB 318, Urban Water Suppliers: Desalinated Water, which would require describing "opportunities for desalination as a long term supply." Both bills are being considered by committees.

In San Diego, a coalition of environmental organizations purchased an advertisement promoting the benefits of desalination in the context of relieving pressure on the Salton Sea and assuring adequate flows to sustain the Sea. Many environmental organizations throughout the State are beginning to develop internal policy statements concerning desalination.

Research is being conducted on desalination in California by several organizations on several different topics. Those conducting research include members of the U.S. Desalination Coalition, State Energy Resources and Conservation Commission, U.S. Bureau of Reclamation, Poseidon Resources, faculty at various academic institutions, among others.

On March 28-29, 2003, the Metropolitan Water District convened a workshop in Pomona among desalination experts to identify the key research needs related to desalination in California. The workshop focused on identifying key issues and approaches to addressing those issues. The report summarizing the outcomes from the workshop should be a useful tool for the Task Force.

This overview provides only a glimpse into the range of activities involving the use of desalination, both inland and on the coast, using both brackish and ocean water. The Task Force will be informed by all these activities. It will not attempt to duplicate but rather to build on each of these and many other initiatives related to desalination.

**TABLE B-1**

**EXISTING DESALINATION FACILITIES ALONG THE CALIFORNIA COAST**

<b>Operator / Location:</b>	<b>Public/ Private:</b>	<b>Purpose:</b>	<b>Maximum Capacity:</b>	<b>Technology</b>	<b>Source Water:</b>	<b>Discharge:</b>	<b>Status:</b>
Chevron / Gaviota	Private	Processing	410,800 gpd, 460 AF/yr.		Ocean	Ocean	Active
City of Morro Bay	Public	Domestic	600,000 gpd, 672 AF/yr.		Seawater wells	Not known	Not known
City of Santa Barbara	Public	Domestic			Ocean	Not known	Inactive
Duke Energy / Morro Bay Power Plant	Private	Power plant	430,000 gpd, 482 AF/yr.		Ocean	Blend w/ cooling water	Not known
Duke Energy / Moss Landing Power Plant	Private	Power plant	480,000 gpd, 537 AF/yr.	Distillation	Ocean	Blend w/ cooling water	Active
Marina Coast Water District	Public	Domestic	45,000 gpd, 50 AF/yr.	RO	Seawater wells	Injection well (beach)	Active
Monterey Bay Aquarium	Private	Aquarium visitor use	40,000 gpd, 45 AF/yr.	RO	Ocean	Combined w/ other seawater discharges	Active
PG&E, Diablo Canyon / San Luis Obispo County	Private	Power plant	576,000 gpd, 645 AF/yr.		Ocean	Blend w/ cooling water	Not known
San Simeon / San Luis Obispo County	Public	Visitor center	10,000 gpd 11 AF/yr.		Ocean	Not known	Inactive
Santa Catalina Island	Public	Domestic	132,000 gpd 148 AF/yr.		Seawater wells	Not known	Not known
U.S. Navy / San Nicolas Island	Public (Military)	Domestic	24,000 gpd 27 AF/yr.		Seawater wells	Not known	Not known
Various offshore oil & gas platforms	Private	Platform uses	2,000–34,000 gpd, 2 – 38 AF/yr.		Ocean	Ocean	Active

**TABLE B-2**

**PROPOSED DESALINATION FACILITIES ALONG THE CALIFORNIA COAST**

<b>Proponent / Location:</b>	<b>Public/ Private:</b>	<b>Purpose:</b>	<b>Maximum Capacity:</b>	<b>Technology</b>	<b>Source Water:</b>	<b>Discharge:</b>	<b>Status:</b>
Cambria Community Services District / San Simeon	Public	Domestic	430,000 gpd, 481 AF/yr.	RO	Seawater well	Subsurface exfiltration (beach)	Planning
Cannery Row Marketplace / Monterey	Private	Private development	5,000 gpd. 6 AF/yr.	RO	Ocean	Pipeline to ocean	FEIR certified by City of Monterey
Carmel Area Wastewater District	Public		Not known		Not known	Not known	Not known
City of San Buenaventura	Public	Not known	Not known		Not known	Not known	Not known
City of Sand City	Public	Domestic	27,000 gpd, 50 AF/yr.	RO	Seawater wells	Injection well (beach)	Planning
City of Santa Cruz / Santa Cruz		Domestic	2.5 mgd w/ expansion	RO	Ocean	Blend w/ sewage outfall	Plan being assessed
East-West Ranch / Cambria	Private	Domestic	Not known		Not known	Not known	Withdrawn
Fort Ord State Park / Monterey County	Public	Domestic	Not known		Not known	Not known	Being researched
Long Beach / Haynes Generating Station	Public	Research	300,000 gpd	Two stage NF	Ocean	Seawater reconstituted from permeate and concentrate	Design/construction
Long Beach / Unknown	Public	Domestic	9 mgd, 9- 10,000 AF/yr.	Two stage NF	Ocean	Unknown	Initial planning
Los Angeles Department of Power and Water / Playa del Rey	Public	Domestic	12 mgd, 11,000 AF/yr.	RO	Ocean	Blend w/ cooling water	Planning, 2010 target
Metropolitan Water District of Southern California		Domestic	5 mgd, 5600 AF/yr.		Ocean	Not known	Not known
Monterey Bay Shores / Monterey County	Private	Private development	20,000 gpd	RO	Seawater wells	Injection well (beach)	Not likely, backup plan

**TABLE B-2 (Continued)****PROPOSED DESALINATION FACILITIES ALONG THE CALIFORNIA COAST**

Monterey Peninsula Water Management District, Carmel River / Sand City	Public	Domestic	6—9 mgd	RO	Seawater wells	Injection well	Preliminary work on EIR
Municipal Water District of Orange County / Dana Point	Public	Domestic	27 mgd, 30,240 AF/yr.	RO	Ocean	Pipeline to ocean	Working on DEIR
Poseidon Resources / Huntington Beach	Private	Municipal ~ 7% of demand	50 mgd	RO	Ocean	Blend w/ cooling water	DEIR 2006 target
San Diego County Water Authority & Poseidon Resources / Carlsbad	Public/private partnership	Domestic ~10% of demand	50 mgd, 56,000 AF/yr.	RO	Ocean	Blend w/ cooling water	feasibility study completed; 2007 target
Sterling Hotel / Sand City	Private	Private development	20 AF/yr.		Seawater wells	Not known	Not known
Santa Cruz County Sanitation District	Public	Domestic	3-14 mgd		Not known	Not known	Planning
U.S. Navy, North Island Naval Air Station / San Diego	Public (Military)	Power plant	700,000 gpd		Seawater wells	Not known	Not known
West Basin Municipal Water District / El Segundo	Public	Domestic ~15% of current supply	20 mgd, 22,400 AF/yr.	RO with MF	Ocean	Blend w/ cooling water	Pilot project on-line (20 gpm), 2008 target

\*\* A compilation of information provided by: the California Coastal Commission, Monterey Bay National Sanctuary, Metropolitan Water District partners (Long Beach Water Department, Los Angeles Department of Water and Power, Municipal Water District of Orange County, San Diego County Water Authority and West Basin Municipal Water District) and Poseidon Resources.

## **Appendix C: Assessment Contacts**

- 1. Department of Water Resources:** Jonas Minton, Charles Keene
- 2. California Coastal Commission:** Jaime Kooser, Tom Luster
- 3. State Energy Resources Conservation and Development Commission:** John Sugar, Wendell Bakken
- 4. California Environmental Protection Agency:** Kathy Fletcher, Don Owens
- 5. State Department of Health Services:** John Hulquist
- 6. The Resources Agency:** Tim Ramirez
- 7. State Water Resources Control Board:** Jim Kuykendahl, Art Baggett
- 8. CALFED:** Sergio Guillen
- 9. State Department of Food and Agriculture:** Steve Shaffer
- 10. University of California:** Henry Vaux (Asst. VP, University of California System), Robert Wilkinson (University of California, Santa Barbara)
- 11. United States Department of Interior:** Kevin Price (Bureau of Reclamation, Denver), Bob Schaefer (Bureau of Reclamation, Mid-Pacific Region)
- 12. A Regional Water Quality Control Board:**
- 13. Local Agency Health Officer:** Larry Honeybourne (Orange County), Ken Clark (California Conference of Directors of Environmental Health)
- 14. Environmental Advocacy Groups:** The Ocean Conservancy (Kaitlin Gaffney, Greg Helms), Sierra Club (Mark Masara, Bruce Monroe), Surfriders (Marco Gonzalez), Bay Institute (Grant Davis), Planning and Conservation League (Fred Keely), NRDC (Jared Huffman, Barry Nelson), Bay Keepers (Steve Fleischli), Mono Lake Committee (Fran Spivy Weber), Nature Conservancy (Jennifer Martin), Environmental Defense (Rod Fujita), Environmental Water Caucus (David Nesmith), Heal the Bay (Mark Gold)
- 15. Consumer Advocacy Group:** Clean Water Action (Michael Stanley Jones), Public Citizen (Jane Kelly)
- 16. Water Purveyors/Districts:** San Diego County Water Authority (Ken Weinberg), East Bay Municipal District (Hasan Abdullah), Metropolitan Water District of Southern California (Anatole Falagan, Kathy Cole), West/Central Basin Municipal Water District (Darryl Miller, Art Aguilar), Marin Municipal Water District (Jared Huffman), Long Beach

Water District (Kevin Wattier, Matt Lyons), San Francisco PUC (Cheryl Davis, Mike Carlin), Sunol Valley WTP (Gary Williams), Santa Clara Valley Water District (Greg Zlotnik), Municipal Water District of Orange County (Stan Sprague)

- 17. A Nonprofit Association Involved in Desalinated Water:** ACWA (Steve Hall, Krista Clark), National Water Research Institute (Ron Linsky)
- 18. A Land Development Official:** Building Industry Association (Brian White)
- 19. Industrial Interest:** Poseidon Resources (Peter MacLaggan), Parsons Engineering (Dennis Kasper)
- 20. Federal agency permitting jurisdiction:** NOAA (Becky Smyth), Monterey Bay National Marine Sanctuary (Brad Damitz)
- 21. Estuarine permitting jurisdiction:** BCDC (Will Travis, Jeffrey Blanchfield, Lindy Lowe)
- 22. Brackish water interests:** Calleguas Municipal Water District (Dee Zinke); Inland Empire Utility District (Rich Atwater)
- 23. State regulatory authority:** California Department of Fish and Game (Patty Woolf)
- 24. Local government:** League of Cities (Evyonne Hunter), County Supervisor Association of California (Steve Szaly)
- 25. Policy Research Institute:** Pacific Institute (Peter Gleick)

## **Appendix D: Detailed Summaries of Assessment Interviews**

**A. General Comments.** This section summarizes general comments made about how desalination, and its related issues, should be addressed by the Task Force.

### Scope

- The Task Force should identify and agree upon management objectives, and what the State should manage towards, concerning desalination
- The Task Force should avoid efforts to determine the pros and cons of desalination generically; rather, case-by-case determinations of costs and benefits are necessary to assess the acceptability of desalination facilities
- The Task Force needs to complete its work by the end of 2003
- The Task Force should provide recommendations on the overall role the State should play in promoting and regulating desalination facilities
- Guidelines are needed to avoid bad investments in desalination facilities
- Until more research is conducted to reduce the costs, desalination should not be conducted on a large scale
- It is important to put all the key issues on the table and deal with them; otherwise, they will likely impede progress on desalination in the future

### Objectives

- Coastal desalination facilities must meet the requirements of the Coastal Act as well as the Public Trust Doctrine
- The Task Force should help DWR develop guidelines for Proposition 50 funding related to desalination facilities
- The Task Force should coordinate its efforts with updating the State Water Plan

### Approach

- The State should push desalination, there is no choice; but it should be done in an environmentally acceptable manner
- Acceptability of desalination requires analyzing it from a holistic perspective – species requirements, land use compatibility, water conservation and reuse, security, etc.
- The key to long term success of siting desalination plants is to assure the first few facilities clearly result in environmental benefits

### Public Involvement

- Many issues associated with desalination facilities need more public education and awareness
- Need to develop a primer for public education on different methods of desalination and their specific implications related to energy, costs, environmental, among other impacts.

**B. Permitting and Regulatory Issues.** With more than 20 local, State and federal permits potentially required for a desalination facility, many believe more coordination is



necessary to make the permitting process less cumbersome. This section provides insights into the issues concerning permitting and regulatory processes, and how they might be improved. Appendix D provides a summary of the major permits required to construct and operate a desalination facility.

- General principles for permitting and regulating desalination facilities should be adopted by all agencies with jurisdictional responsibilities
- Guidelines should be developed for quick review to indicate the likelihood of approval or disapproval of a desalination facility
- Water rights issues, particularly in estuaries, need to be addressed; it would be a mistake to avoid the issue of water rights
- Developing a general permit for desalination facilities might be the best approach, but this would require legislative initiative
- Need to make the overall regulatory/permitting process more efficient
- Not having bay, coastal and marine waters designated by Regional Boards as a drinking water supply in Basin Plans presents a regulatory dilemma
- The extent to which dilution credits might be applicable should be clarified.

**C. Energy Issues.** Almost universally, those interviewed cited the energy required for desalination as a major issue to be addressed. Some believe the energy issues associated with desalination can best be solved by co-locating with coastal power plants and acquiring energy from sources other than the grid. Others are concerned about tying desalination too closely to coastal, once-through power plants. Many suggest new, alternative sources of power should be the focus.

#### Energy Consumption

- Ways to reduce energy costs need to be developed
- Methods of energy recovery need to be identified and explored
- The potential demand on the grid is unknown and should be assessed
- New, renewable sources of energy should be explored for application to desalination, including geothermal, wind and tidal/marine current turbines
- The energy required for desalination facilities should be compared with the energy required to pump water from one region to another to assess energy impacts fully.

#### Energy Sources

- What are the pros and cons of emphasizing that desalination facilities be co-located with energy facilities?
- The impacts of moving to dry cooling for power plants needs to be considered, particularly if the major strategy is to attach desalination facilities to power plants
- Currently, for desalination to work economically on a large scale, the facility needs to be “inside the fence” of a power generation facility and not pull energy from the grid
- The future of energy is likely to be smaller, less centralized facilities; therefore, tying desalination too closely to large power plants is a mistake, as they will soon be “yesterday’s” technology

**D. Economic Issues.** Another issue and concern raised almost universally is that of the costs of energy required for desalination. Other cost issues are also cited, such as the environmental costs, and benefits, associated with desalination. Almost everyone acknowledges that coastal desalination was not considered a viable option, financially, until two factors recently began to merge: the increased cost of water (to store or transport long distances) and the reduced cost of desalination (caused by improved, longer lasting membranes requiring less energy). Even with this combination of factors, most still remain concerned about the costs of desalination and believe more attention should be given to find ways to reduce costs. Several also voiced the concern that without subsidies, desalination on its own merits might still not be financially viable.

#### Economic Analyses

- Realistic economic costs of developing desalination plants need to be determined, testing the assumptions included in most desalination facilities being planned today
- The Task Force needs to conduct an independent analyses of power costs
- Economic analyses should look at relative costs of desalination as a water supply versus water pumped from long distances, recycled water, etc.; long-term projections should be part of the analysis
- Need to address benefits and costs on a broad scale, including the benefits gained by other than those who incur the cost of developing the water
- Is inland brine disposal cost-effective, particularly if the end product is determined to be a hazardous waste?

#### Economic Assistance

- What incentives to help defray or underwrite the costs of desalination plants might be possible?
- Need to identify strategies for creating financial efficiencies in developing and operating desalination facilities.

#### Economic Benefits

- An economic advantage is that desalination as a water supply source can be developed in modules, not as a one-time major capital expenditure like building new dams
- The feasibility of not operating desalination plants when the water is not needed should be evaluated

**E. Planning Issues.** The most critical planning issue raised by many of those interviewed is the potential growth inducing impacts of desalination. As such, those who hold this perspective believe growth impacts associated with desalination must be addressed by the Task Force. On the other hand, some believe this is outside the scope of the Task Force since desalination should be treated as any other potential source of water. The Coastal Commission has noted, however, as an essential component of its jurisdictional responsibilities and through the CEQA process, more than twenty years of experience exists related to dealing with growth in permitting processes. As such, the

growth inducing impacts of desalination should be considered in the context of existing regulatory and permitting processes, benefiting from the long track record in dealing with growth inducement. Some suggest the main focus related to growth impacts should be reaching agreement on the steps necessary to meet regulatory requirements.

#### Growth Inducement

- How can the issue of growth inducement associated with desalination facilities best be addressed?
- Desalination is no more or less growth inducing than other water supplies; even conservation could be considered as growth inducing
- Some uses of desalinated water should not be considered as growth inducing, such as use for drought protection, replacing a water source which is no longer available, and ecosystem restoration or sustainability
- Growth inducement issues should be keyed to existing planning and regulatory requirements
- Growth inducement is a planning not a water supply issue; regional associations of governments supply population and land use projections to water providers, who then try to meet the needs identified
- If the Coastal Commission has approved a Local Coastal Program, that may be the extent of review required for growth inducement; but LCPs are highly variable
- While growth inducement is an important issue, it should be kept in the proper context since the Task Force will not be able to answer all the issues pertaining to the relationship between water and growth

#### Planning Objectives

- It would be desirable to develop long-term regional projections and plans so projects will be ready to go when needed
- Desalination for “private” use should be avoided, in keeping with principals of the Coastal Act
- Developing comparative environmental cost/benefit analyses of desalination versus other sources of water may be one approach to determining the environmental acceptability of a desalination facility.

**F. Siting Issues.** Siting is an issue several of those interviewed believe should be a critical aspect of the Task Force’s work. Siting involves not only the location of the desalination facility, but the source of water (e.g., wells, ocean water) and associated entrainment and water quality issues, as well as the impacts of the outfall. Some suggest this is why case-by-case analyses of desalination facilities are needed, since siting affects energy and cost issues along with environmental acceptability.

- Address land use compatibility issues in siting facilities
- Water supply from desalination should be considered in the context of other available water supplies (including from other areas of the State or region), the proposed use of the desalinated water, and the trade-offs between developing and producing desalinated versus other sources of water supply

- Is it possible to determine an upper limit on how many desalination facilities can be appropriately located along the coast?
- Public access needs to be addressed
- The visual impacts of desalination facilities should be considered, which may affect public perceptions of the technology
- Proliferation of improperly regulated, modular, floating desalination units is a concern, along with small facilities in locations not well suited for desalination.

**G. Entrainment Issues.** Of the environmental issues mentioned in interviews, entrainment is one of the major concerns associated with ocean water desalination. Some of those interviewed suggest that if desalination is too closely linked with once-through power plant cooling the historic environmental concerns with power plant entrainment might be a liability for desalination. The primary entrainment concerns involve the loss of individual organisms as well as biodiversity.

#### Analyses

- Identify the seawater/entrainment water quality and characteristics required, or most efficient, for desalination
- Identify pretreatment requirements for reverse osmosis and other methods of desalination
- Identify the organisms most affected by entrainment, and how they are affected
- Identify the potential ecological impacts of both entrainment and impingement
- Identify and evaluate ways to mitigate the impacts of entrainment on organisms and ecosystems.

#### Strategies

- Siting is critical to reduce impacts on estuarine and marine environments
- Ways of reducing the amount of water extracted from natural systems should be explored (for example, using treated and recycled wastewater, well water, etc.)

**H. Distribution and Outfall Issues.** The major environmental concern expressed relates to brine disposal and effluent impacts. Nearly everyone interviewed cited brine disposal as a key issue. Most believe, however, this is an issue that can be mitigated under most circumstances. Those who remain concerned cite not just the increased salinity but also the concentration of metals and other elements. The type and location of brine discharges also was noted as a key issue related to the environmental acceptability of desalination facilities. An additional issue to be considered is the impact of desalinated water on the stability of distribution systems.

#### Analyses

- More information is needed on the stability and impact of desalinated water on distribution systems
- Identify appropriate or optimal marine substrates for brine outfall locations
- Clarify the potential ecological impacts of brine disposal
- Identify and evaluate the different approaches to discharging brine

- Fully characterize the waste stream associated with brine disposal, as well as the potential toxicity

#### Strategies

- Siting is critical, and the issues may vary considerably between open ocean and estuarine settings
- Since non-point source runoff sometimes creates “dead zones” in estuaries, the potential benefits of mitigating these situations with brine disposal should be considered
- The potential benefits and drawbacks of blending brine with wastewater outfalls should be considered; in marine environments, this could affect buoyancy issue as well
- The potential application of standards for brine disposal characteristics, and/or its impacts, should be explored
- Education might be needed to address public acceptance of desalinated water as drinking water.

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## Appendix E: Regulatory Agencies and Permitting Responsibilities

<b>POTENTIAL MAJOR PERMITS AND APPROVALS REQUIRED OCEAN DESALINATION PROJECT</b>				
<b>Responsible Agency</b>	<b>Permit, Approval, or Review</b>	<b>Potentially Applicable To</b>	<b>Estimated Time Frame <sup>a</sup></b>	<b>Public Hearing Requirements</b>
<b>FEDERAL</b>				
Army Corps of Engineers (ACOE)	<ul style="list-style-type: none"> <li>Section 10 (Rivers and Harbors Act)</li> </ul>	Seawater intake; offshore pipeline to shore; outfall line in “navigable waters” of the U.S., would be processed in conjunction with the Section 404 permit	12 months	None
	<ul style="list-style-type: none"> <li>404 Permit (Clean Water Act)</li> </ul>	Seawater intake; offshore pipeline to shore; outfall line in “navigable waters” of the U.S., would be processed in conjunction with the Section 10 permit. The Corps has indicated that an individual permit would be required.	12 months	Optional, at discretion of District Engineer
	<ul style="list-style-type: none"> <li>National Environmental Policy Act (NEPA) Compliance</li> </ul>	Required because of the federal action involved in issuing the Section 404/10 permit. Corps would be the lead agency and has indicated it would require an EIS	12 months concurrent w/ Section 10/404 Process	Yes
U.S. Fish and Wildlife Services	Commenting agency to Corps, Responsible for compliance with federal Endangered Species Act	All project components that involve federal land and/or require federal permits and/or approvals. It is anticipated that this project does not have the potential to affect any federal listed species. Therefore, a formal consultation under Section 7 of the Endangered Species Act probably would not be required	12 months	None

Continued

**POTENTIAL MAJOR PERMITS AND APPROVALS REQUIRED  
OCEAN DESALINATION PROJECT**

<b>Responsible Agency</b>	<b>Permit, Approval, or Review</b>	<b>Potentially Applicable To</b>	<b>Estimated Time Frame <sup>a</sup></b>	<b>Public Hearing Requirements</b>
U.S. Coast Guard	Review of Section 10 permit and Approval of Operations	Vessels, traffic safety and navigation hazards potentially associated with offshore intake structure. Will consult with Corps during Section 10/404 process.	12 months	None
NOAA – National Marine Fisheries Service	Commenting agency to Corps; must determine if project has potential to impact Essential Fish Habitat; responsible for marine fishes and marine mammals covered under federal Endangered Species Act	Offshore components with potential to impact marine fisheries or marine mammals. It is anticipated that this project does not have the potential to affect any federal listed species. Therefore, a formal consultation under Section 7 of the Endangered Species Act probably would not be required	12 months	None
State Historic Preservation Office	Section 106 Compliance, National Historic Preservation Act	Construction, operation, and/or abandonment of facilities on lands under federal jurisdiction	6 months	None
<b>STATE</b>				
Coastal Commission	<ul style="list-style-type: none"> <li>Coastal Development Permit</li> </ul>	All project components within areas of “original jurisdiction” as shown on official Local Coastal Plan Post-Certification map	12 months	Required as part of the regular Coastal Development Permit process
	<ul style="list-style-type: none"> <li>Consistency Determination</li> </ul>	Offshore components requiring federal approval. The coastal Commission has indicated it would process a joint Coastal Development Permit/Consistency Determination for this project	12 months	Required

Continued

**POTENTIAL MAJOR PERMITS AND APPROVALS REQUIRED  
OCEAN DESALINATION PROJECT**

<b>Responsible Agency</b>	<b>Permit, Approval, or Review</b>	<b>Potentially Applicable To</b>	<b>Estimated Time Frame <sup>a</sup></b>	<b>Public Hearing Requirements</b>
Department of Health Services, Office of Drinking Water	• Amended Domestic Water Permit	Required to assess quality of delivered water, proposed treatment facilities, etc. Offshore intake structure.	2-3 months	None
	• Source Water Assessment and Protection Plan		6 months	None
Regional Water Quality Control Board, San Diego Region (RWQCB)	• NPDES Permit or Waste Discharge Permit	Desalination brine discharge via ocean outfall Certify that discharge into Corps jurisdiction will not have adverse water quality impacts	6 months	Hearing required before Regional Water Quality Control Board; decision appealable to State Water Resources Control Board
	• 401 – Water Quality Certification		2 months	
State Lands Commission	Possible lease permit for area below mean high tide line (1)	Offshore components on any un-granted tidelands	6 months	Yes
California Department of Fish and Game	CEQA review, review of draft NPDES permit, consulting agency to Corps and Coastal Commission	CDFG will review EIR/EIS and will consult with Corps and Coastal Commission regarding impacts to biological resources	12 months	None
California Department of Transportation (CalTrans)	• Encroachment Permit	Trenching/excavation within a State highway	3 months	None
	• Coastal Development Permit (assessment consistency with Local Coastal Plan)	Onshore project components (decision appealable to California Coastal Commission)	6 Months	Planning Commission decision appealable to City Council. Council decision appealable to Coastal Commission for portion within



**POTENTIAL MAJOR PERMITS AND APPROVALS REQUIRED  
OCEAN DESALINATION PROJECT**

Responsible Agency	Permit, Approval, or Review	Potentially Applicable To	Estimated Time Frame <sup>a</sup>	Public Hearing Requirements
				appealable coastal area
South Coast Air Quality Management District	Construction Permit, Title V Permit	Continued Construction and operation of the project	6 Months	None
(1) The State Lands Commission typically consults with the State Historic Preservation Officer regarding potential impacts to cultural resources (e.g., shipwrecks) in State waters. This review/consultation would occur as part of the CEQA compliance process as well.				
<b>LOCAL</b>				
County of Orange County Property Permits	Encroachment on State Tidelands Granted to County.	Offshore or Beach Structures.	2 Months	No
City of Dana Point	Discretionary land use/zoning permits (i.e. Use Permit, Flood Plain Overlay Zone Permit, etc.) <sup>b</sup>	Construction and operation of project depending on location	3-6 Months	Planning Commission decision; appealable to City Council
<p>a. The listed time frames for permit approval are estimated typical agency processing and review time frames. These time frames typically begin after the appropriate environmental review document has been certified. These estimated time frames could vary widely depending on length of staff review, degree of public involvement in the environmental review and permitting process, and the number and duration of potential appeals.</p> <p>b. Section 53091 of the government code states that "zoning ordinances of a county or city shall not apply to the location or construction of facilities for the production, generation, storage, or transmission of water..." such an exemption may apply to all or portions of the proposed project(s).</p>				

## **Regulatory Agencies that may require permits for seawater desalination**

- **U. S. Army Corps of Engineers** – The ACOE regulates activities involving the nation’s waters under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbor Act. Section 404 addresses discharge of dredge or fill material into water of the U.S., including wetlands.
- **Air Quality Management Districts**
- **Bay Conservation and Development Commission** - BCDC oversees permits to place fill, extract materials or make any substantial change in use of any water, land or structure within its jurisdiction, as delegated under the McAteer-Petris Act. It also has federal consistency review under the Coastal Zone Management Act of 1972 as amended, and permit authority over Suisun Marsh as a result of the Suisun Marsh Restoration Act of 1977.
- **California Coastal Commission** – They are the lead agency for California’s coastal management program under the California Coastal Act. Any facilities proposed within the coastal zone are required to obtain a coastal development permit (CDP) prior to construction.
- **California Department of Fish and Game** - Any project that distributes domestic water must comply with the Safe Drinking Water Act (SDWA). Any projects that may impact or jeopardize a State-listed species must consult with the CDFG on regulations concerning the Streambed Alteration Agreement process (Section 1601).
- **California Department of Health Services, Office of Drinking Water and Toxic Substances Control Division**
- **California Department of Parks and Recreation**
- **California Department of Transportation**
- **California Energy Commission**
- **California Public Utilities Commission**
- **City and County Planning Commissions, City Councils, and Boards of Supervisors**
- **County Departments of Environmental Health**
- **National Marine Fisheries Service**
- **Port Authorities**
- **Port Districts**
- **State Department of Water Resources** – Permission must be sought from the State if the agency intend to use facilities belonging to the State Water Project, CVP, or other entity for water transfers.

- **State Lands Commission** - A lease or permit from the State Lands Commission (SLC) for use of State lands if the project will be located in the SLC's jurisdiction area.
- **State Regional Water Quality Control Boards** - NPDES (National Pollutant Discharge Elimination System) to discharge seawater desalination wastes (e.g., brine) with jurisdiction in the area of the proposed project. Waste discharged into surface waters is subject to NPDES permitting.
- **State Water Resources Control Board**
- **U.S. Bureau of Reclamation**
- **U.S. Coast Guard**
- **U.S. Environmental Protection Agency**
- **U.S. Fish and Wildlife Service** – USFWS in conjunction with National Marine Fisheries Service (NMFS) enforces rules and regulations under the federal Endangered Species Act (ESA). Section 9 of the ESA prohibits any harm to federally listed species and Section 7 requires that federal agencies ensure that their actions do not jeopardize the continued existence of the species and its survival.
- **U.S. Minerals Management Service (for equipment installed on OCS platforms)**

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## **Appendix F: Comments on Preliminary Collaborative Process Design**

### Scope

- The process should focus on what is outlined in AB 2717, and not include other issues
- It is important to put all the key issues on the table up-front
- Task Force deliberations should be based on sound science and technical information, not just be a “debate society.”

### Cost

- The initial estimate of costs to conduct the process seems too high
- Need to raise sufficient funds to conduct the process properly
- If the full project budget cannot be raised it may not be worth proceeding.

### Participation

- The selection of Task Force members is important; they should have knowledge of desalination and commit to attend regularly
- Protocols should be established so everyone has a common understanding of the level of participation required to be on the Task Force
- Locations of meetings should be kept constant so they are not always moving around
- Since many local agencies have regulatory responsibilities, the Task Force should not be overly weighted or oriented towards State agencies
- Working Groups will be essential to the work of the Task Force to engage appropriate expertise efficiently.

### Public Involvement

- Public workshops at the beginning of the process will be much more helpful than if held towards the end of the process.

### Process Management

- Is it really necessary to have five Working Groups?
- Is a team of three facilitators essential?
- The project needs to be completed by the end of 2003
- Isn't it unlikely all the work of the Task Force can be accomplished by the end of the year?
- This has an extremely ambitious schedule
- It probably will not be necessary to obtain too much outside assistance with technical issues
- Obtaining technical assistance for the Task Force will be critical.

## **Appendix G. Status of Technical Information and Potential Areas of Technical Support**

Based on interviews with a wide range of technical experts, consultants and researchers, it is clear that significant research is being conducted on desalination, both in California and around the world. Research is being conducted on such varied topics as membrane and energy efficiency, energy use, aquatic impacts of brine disposal, impacts of variable entrainment water characteristics, outfall options, impacts of introducing desalinated water into water distribution systems, alternative energy sources, optimal siting criteria, among other topics.

It is also clear that the information is highly fragmented. Efforts are underway by several agencies, however, to improve the accessibility of information. The Bureau of Reclamation (Denver office), for example, has been provided funding by Congress to establish a Desalination Clearinghouse. But this effort is just beginning and will not be fully functioning during the tenure of the Task Force.

As such, an effort was made during this issues assessment to compile as much information as possible on technical studies and research related to desalination in California. This should serve as a baseline for consideration by the Task Force, to help identify information gaps considered important to conducting its work. It will also make the process of obtaining technical assistance as efficient and cost-effective as possible. Table G-1 contains a summary of the information compiled to date, representing an ongoing effort that will likely continue throughout the duration of the Task Force's work.

A number of thoughts pertaining to technical information and research were expressed during interviews. These include:

- Avoid identifying a "wish list" of desirable research on desalination; rather, identify what additional information is necessary for the Task Force to complete its work
- Research and technical information is expanding rapidly related to desalination, but it is highly fragmented; efforts are needed to compile available information
- Research is needed to develop the means to reduce the energy costs per unit of water
- Research is needed on the impacts of desalinated water on pipeline distribution systems
- Research is needed to reduce the pressure required across membranes to achieve desalination
- Develop membranes that work at 20 psi
- How much modeling is required to understand fully the impacts of brine disposal?
- The Task Force should focus research/technical information needs on what is needed to accomplish its objectives

- More research is needed on the impacts associated with distillation since most research is focused on membrane technology
- Analyzing the literature on coastal power plants should provide valuable information concerning entrainment and impingement.

This list, among other technical and research related issues, will be addressed by the Task Force to ascertain what is needed to complement its work and meet its stated objectives.

Given the proposed timeline of the project, the Task Force will not be able to develop a research agenda that can provide results during its tenure. Nonetheless, the Task Force is in a position to evaluate existing information and research, and apply that information to its work. Most importantly, the Task Force must identify the technical information and the types of technical support it needs to make informed policy decisions.

It is the purview of the Task Force to identify those areas where analysis and assessment of existing information can be of assistance in achieving its objectives. For the purpose of focusing discussions on needed technical support, however, the following list represents some potential topics requiring technical support:

- 1) Analysis of energy use, and costs, associated with different desalination technologies
- 2) Independent analysis of real costs of producing potable water using desalination
- 3) Comparative analysis of energy used by desalination versus transferring water from one region to another
- 4) Assessment of future trends in energy production, and the potential application of new and alternative energy sources to desalination
- 5) Summary of techniques available to reduce the ecological impacts of entrainment, and their effectiveness
- 6) Analysis of costs and benefits of blending brine with other effluents (e.g., power plant, wastewater)
- 7) Assessment of optimal entrainment and outfall locations, and other important siting considerations.

Information gained from the research highlighted in Table G-1 will be introduced into the work of the Task Force, and provide a basis for its deliberations. The list above represents examples of topics for which additional technical assistance (information synthesis, analysis and interpretation) might be helpful and useful.

**TABLE G-1**

- \* Reports available on-line at: [www.usbr.gov/water/reports.html](http://www.usbr.gov/water/reports.html) (report number indicated)
- \*\* Reports available on-line at: [www.twdb.state.tx.us](http://www.twdb.state.tx.us) (click on “Desalination Activities” – third bullet from the top; then click on “Recent TWDB Research on Desalination”)  
DRIP: refers to a task of the Desalination Research and Innovation Partnership and identifies the lead agency

### **Facilities Information:**

- Ocean desalination facilities matrix
- *Local Resources Program: Recycled Water and Groundwater Recovery Projects*, MWD, 12/01 Status Report
- *National Centers for Water Treatment Technologies*, summary from NWRI website [www.nwri-usa.org](http://www.nwri-usa.org) describing the National Centers program and research facilities.
- *National Facilities Survey - Part 1*, 1994, Separation Consultants. \* (report #12)
- *National Facilities Survey - Part 2*, 1997, Separation Consultants. \* (report #38)

### **Reference Materials**

- *The ABCs of Desalting*, 2000, O.K. Buros. International Desalination Association.
- *The Desalting and Water Treatment Membrane Manual: A Guide to Membranes for Municipal Water Treatment*, 1998, USBR. (report #29)
- *Desalting Handbook for Planners*, 2002, Bureau of Reclamation. 234 pp.
- *National Desalting and Water Treatment Needs Survey*, 1993, USBR. (report #2)
- Non-Thermal Technologies for Salinity Removal, DRIP, Metropolitan Water District
- *Reverse Osmosis and Nanofiltration*, 1999, American Water Works. 173 pp.

### **Research Projects**

- *Water Quality Implications of Large Scale Application of Seawater Desalination Project*. An AWWARF “Tailored Collaboration” project. Proposal prepared by McGuire Environmental Consultants, Inc., 8/17/01. (See scope of work at end of Table G-1)
- *Improving Energy Usage, Water Supply Reliability and Water Quality Using Advanced Water Treatment Processes*. Undertaken by the Desalination Research and Innovation Partnership, managed by Metropolitan Water District. 71 different research tasks incorporated into this Technical Information Framework.

### **Research Needs**

- *Desalination Research Partnership: Research Needs for Producing Potable Supplies from Seawater Desalination*, Proposal prepared by McGuire Environmental Consultants, Inc., 4/15/02 (Identifies additional research needed to complement the “Tailored Collaboration” project) Funded by AWWARF.
- *Desalination Research and Development Workshop*, 2001, National Water Research Institute and USBR. \* (report #64) Note: results from 3/2003 workshop not yet posted.

- *Desalination and Water Purification Technology Roadmap*, 2003. Bureau of Reclamation and Scandia Laboratories. \* (report #95)
- *Report to Congress - Desalination & Water Purification Research & Development Program*, 2001, USBR, Denver, CO. \* (Report #67)
- *Water Reuse Research Needs Assessment Workshop*, Summary Report of 8/4/96 Reclamation Workshop Held at the ADA Conference in Monterey, CA. \* (report #19)

## **Technical Issues**

### **1. Operations Issues** (related to how the facility works, involves operating agencies)

#### **1.1. Water Quality**

- *Preliminary Pilot Plant Water Quality Report*, [need date], McGuire Environmental Consultants for West Basin "Tailored Collaboration" project. Funded by AWWARF. Analysis of feedwater and permeate water quality.
- *Water Quality Issues Related to Seawater Desalination*, 7/3/02, McGuire Environmental Consultants for West Basin "Tailored Collaboration" project. Funded by AWWARF. Addresses feedwater and permeate water quality issues.
- *Existing Treatment Process Removal Efficiencies for Emerging Contaminants*, DRIP, West Basin MWD.

##### **1.1.1. Feedwater sources and quality**

- *Evaluation of a Rapid Test for Quantifying AOC in Membrane Feedwaters*, DRIP, Orange Co. WD.
- *Evaluation of Desalination on Waters Under the Influence of Surface Water Runoff for Pretreatment, Water Quality, and Pathogen Removal Performance* (not yet complete), Reiss Environmental. Funded by USBR.
- *Existing Seawater Quality Data: Draft Report*, [need date], McGuire Environmental Consultants for West Basin "Tailored Collaboration" project. Funded by AWWARF.
- *Identification of Brackish Groundwater Sources for Future Potable use and Their Estimated Desalinization Costs*, (not yet complete), LBG Guyton and Associates; Texas Water Development Board contract.
- *Initial Evaluation of the Subfloor Water Intake System Structure (SWISS) vs. Conventional Multimedia Pretreatment Techniques*, 2001, Pacific Research Group. \* (report #66)
- *Source Water Assessment and Supply Sampling* (proposed, MWDOC)

##### **1.1.2. Permeate water quality**

- *Evaluation of Conventional and Advanced Treatment Processes to Remove Endocrine Disruptors and Pharmaceutically Active Compounds*, (not yet completed), Southern Nevada Water Authority. AWWARF contract #2758.
- *The Algal-Bacterial Selenium Removal System for Treatment of Irrigation Drainage Water: Demonstration Studies*, 1999, UC Berkeley. \* (report #27).



## 1.2. Membrane technology:

- Extensive list of research, journal articles and reports resulting from NWRI funding. (See "NWRI Membrane Research and Articles" on closing pages of Table G-1).
- Application of Membrane Bioreactors...for Water Reuse, DRIP-San Diego Co. WA.
- *Assessment of Current Membrane Desalination Technology and Cost Treatment of Brackish and Saline Waters in Texas*, 8/2000, HDR Engineering; Texas Water Development Board contract. \*\*
- *AWWARF/Reclamation Membrane Workshop*, 2000, American Water Works Association Research Foundation and USBR, Denver, CO. \* (report #63)
- *The Desalting and Water Treatment Membrane Manual: A Guide to Membranes for Municipal Water Treatment*, 1998, Bureau of Reclamation. \* (report #29)
- *Development of Low Pressure Membrane Knowledge Base (MF/UF)*, (not yet completed), Montgomery Watson. AWWARF contract #2763.
- *Evaluation of Methods for Monitoring the Integrity of Reverse Osmosis Membrane Systems*, 2000, USBR, Denver, CO. \* (report #55)
- *Integration of Membrane Filtration in Water Treatment Systems*, (not yet completed), Black & Veatch, USBR. AWWARF contract #2765.
- *Integrated, Multi-Objective Membrane Systems for Control of Microbials and DBP Precursors*, (not yet completed), Kiwa N.V., University of Central Florida, Boyle Engineering Corporation, and American Water Works Service Company. AWWARF contract #264.
- *Membrane Element Autopsy Manual*, 1996, USBR, Denver, CO. \* (report #17)
- *Molecular Sieving Hollow Fiber Ceramic Membranes for Reverse Osmosis / Nanofiltration Membranes*, 1997, Media and Process Technology. \* (Report #40)
- *Optimization of MF/UF Membrane Treatment for Direct and Clarified Water Filtration*, (not yet completed), MWH Global, EPA. AWWARF contract #2864.
- *Polyamide Reverse Osmosis Membrane Fouling and Its Prevention: Oxidation-Resistant Membrane Development, Membrane Surface Smoothing, and Enhanced Membrane Hydrophilicity*, 2000, Separations Systems Technology, and Orange County Water District. \* (report #61)
- *Salinity and TOC Removal Using Nanofiltration*, 2002, University of Texas at El Paso. \* (report #46)

### 1.2.1. Pretreatment

- *Biological Pretreatment for Membrane Systems*, 2003, Montana State University, Bozeman. \* (report #79)
- *Coagulation Pretreatment for Membrane Filtration*, 2002, University of Illinois at Urbana – Champaign. AWWARF publication #90920.
- *Design and Optimization of Biological Reactors for the Pretreatment of Reverse Osmosis Feed Water* (not yet completed), Anne Camper and Montana State University-Bozeman. Funded by USBR.

- *Evaluation of Membrane Pretreatment for Seawater RO Desalination*, (not yet completed), Aqua Resources International and San Patricio Municipal Water District (Ingleside, Texas). Funded by USBR.
- *Evaluation of Various Pre-Treatment Methods for Seawater Membrane Desalination* (not yet completed), Bill Pearce the City of San Diego. Funded by USBR.
- *Innovative Biological Pretreatments for Membrane Filtration*, Malcolm Pirnie and CH2Mhill; AWWARF contract #2570.
- Pre-treating Raw Groundwater Prior to RO, DRIP, San Diego Co. WD.
- Pretreatment for Brackish Alluvial Waters Prior to Reverse Osmosis, DRIP, Sweetwater.
- Ultraviolet Disinfection Processes in Water Reuse Applications, DRIP, Orange Co. WD.

#### 1.2.2. Fouling, Scaling and Cleaning

- Alternative Cleaning of Microfilter Membranes for Backwash Water, DRIP, West Basin MWD.
- *Biofouling in Membrane Processes*, 2002, MWDOC, AWWARF contract #904.
- Biofouling of Membrane-Treated Municipal Wastewater, DRIP, Orange Co. Water District.
- Correlations Between Membrane Fouling and Water Composition, DRIP, Orange Co. WD.
- Direct Observation of Biofouling Mechanisms During Crossflow Membrane Filtration, DRIP, UC Riverside.
- *Enhancement of Membrane Fouling Resistance through Surface Modification*, 1997, USBR, Denver, CO. \* (report #22)
- Evaluation of Fouling Resistance Membrane, DRIP, West Basin MWD.
- *Evaluation of Precipitative Fouling for Colorado River Water Desalination Using Reverse Osmosis* (not yet completed), UCLA and Metropolitan Water District of Southern California. Funded by USBR.
- *Evaluation of Reverse Osmosis Scaling Prevention Devices at High Recovery*, 2003, USBR, Denver, CO and Yuma, AZ and Burns and Roe Services Corporation, Yuma, AZ. \* (report #91)
- *Hydrophilicity of Polymeric RO & NF Membranes: Implications to Membrane Fouling - Phases I & II* (not yet completed), Amy Childress and University of Nevada at Reno. Funded by USBR.
- *Improving Membrane Performance by Control of Particle Fouling*, (not yet completed), University of Central Florida and Yale University.
- *Membrane Fouling: Influence of Natural Organic Matter*, 2002, Rensselaer Polytechnical Institute, Troy, NY. \* (report #83)
- Membrane Fouling and Mineral Scaling: Analysis, Predication and Control, DRIP, UCLA.

- Membrane System for Low Fouling RO Desalting of Municipal Wastewater, DRIP, San Diego Co. WD.
- Microbial Fouling on RO Membranes Following Ozone / Biofiltration, DRIP, Metropolitan WD.
- *NOM Rejection by, and Fouling of, NF and UF Membranes*, 2001, University of Colorado at Boulder, University of Illinois and National Institute of Standards and Technology. AWWARF publication #90837.
- Non-Proprietary RO Anti-scalant Products, DRIP, West Basin MWD.
- *Optimal Operational Conditions for Prevention of Membrane Colloidal and Organic Fouling* (not yet completed), Menachem Elimelech and Yale University. Funded by USBR.
- Optimize Cleaning Procedures for Reverse Osmosis of Municipal Effluent, DRIP, West Basin MWD.
- Pulsed UV for Biofouling Control, DRIP, Metropolitan Water District.
- *Removal of Biofilm and Other Foulants from Spiral-Wound Reverse Osmosis Membranes* (not yet completed), Ralph Hensler and Novaflux Technologies. Funded by USBR.
- Scale Control for Surface Waters, DRIP, UCLA.
- Scale Control in Reverse Osmosis of Brackish Groundwater, DRIP, Alameda Co. WD.
- Surface Fouling by Mineral Salt Scaling and Dissolved Organics, DRIP, UCLA.
- Unique Chemicals for Optimum Membrane Compatibility & Cleaning Efficacy, DRIP, Orange Co. WD.

#### 1.2.3. Membrane Performance

- Compare Reverse Osmosis and Electrodialysis Reversal for Tertiary Effluent, DRIP, Santa Clara VWD.
- Demonstration-Scale Evaluation of RO Using 16" Elements, DRIP, Metropolitan.
- *Development of an Advanced Transverse Flow Nanofiltration Membrane Process for High Performance Desalination*, 1995, ZENON Environmental, Burlington, Ontario, Canada. \* (report #9)
- *Development of an Advanced Transverse Flow Nanofiltration Membrane Process for High Performance Desalination, Phase II*, 1998, ZENON Environmental, Burlington, Ontario, Canada. \* (report #37)
- Electrodialysis Reversal v. Microfiltration / RO for Brackish Water, DRIP, San Diego Co. WA.
- Investigation of Rejection Behavior/Trace Organic Compounds – Bench Scale, DRIP, Orange Co. WD.
- Investigation of Rejection Behavior/Trace Organic Compounds –Pilot Scale, DRIP, Sonoma Co. Water Authority.
- Investigation of Rejection Behavior/Trace Organic Compounds – Full Scale, DRIP, West Basin MWD.

- *Laboratory Tests of New Membrane Materials*, 2001, University of North Carolina at Chapel Hill and North Carolina State University. AWWARF publication # 90851.
- Large-Scale RO Evaluation, DRIP, Metropolitan.
- *Microfiltration with Rapid Backpulsing and Surface-Modified Membranes*, 2000, University of Colorado; Boulder, CO. \* (report #58)
- *Microfiltration / Reverse Osmosis Pilot Testing Status Report*, 10/15/02, Separation Processes, Inc. for West Basin Municipal Water District. Funded by NWRI.
- *Nanofiltration of a High Salinity Groundwater on the Hopi Reservation*, 1995, Northern Arizona University; Flagstaff. \* (report #3 - evaluates NF membrane performance)
- *Ozone / Biofiltration on Reverse Osmosis Membrane Performance*, DRIP, Metropolitan.
- Performance Testing "Rochem" Disk Tube and Disk Tube Filter Units, DRIP, San Diego Co. Water Authority.
- *Predicting Membrane Flux Decline Using Parameters Derived from Field-Flow Fractionation Measurements* (not yet completed), James Ranville and Colorado School of Mines. Funded by USBR.
- Prediction of Organics Removal by RO Membranes, DRIP, Orange Co. WD.
- Rejection of WW-Derived Micropollutants in HP Membrane Application, DRIP, West Basin MWD
- *A Resistance Model for Evaluating Interactions Between Natural Organic Matter (NOM) and Membranes at Different Scales of Operation*, 1999, USBR, University of Colorado, Boulder. \* (report #44)
- Reverse Osmosis Membrane Integrity, DRIP, San Diego Co. WA.
- Role of MF Cake Composition & Stability in Desalination Efficiency, DRIP, Orange Co. WD.
- *Visualization of Colloidal Phenomena Near Membrane Surfaces* (not yet completed), Mark Clark and University of Illinois. Funded by USBR.
- *Zeta Potential for Reverse Osmosis Membranes: Implications for Membrane Performance and Feed Water Treatment*, 1996, University of California at Los Angeles. \* (report #10)

### 1.3. Cost Estimates and Economic Factors

- Analysis of Cost Effectiveness of RO v. EDR for Municipal Wastewater Reclamation, DRIP, San Diego Co. Water Authority.
- *Assessment of Current Membrane Desalination Technology and Cost Treatment of Brackish and Saline Waters in Texas* (see 1.2 above) \*\*
- *An Expert System for Decision-Making in the Use of Desalination for Augmenting Water Supplies* (not yet completed), Gregory Characklis and the University of North Carolina. Funded by USBR. Will develop communities to comprehensive compare costs of alternative water supplies.

- Cost of Salt Removal from Various Waters – Guidance Manual, DRIP, San Diego Co. Water Authority.
- *Desalination for Texas Water Supply (Part A: Membrane Technologies and Costs; Part B: Economic Importance of Siting Factors for Seawater Desalination)*, 2002, HDR Engineering, Water Resource Associates, Malcolm Pirnie and PB Water. \*\*
- *Identification of Brackish Groundwater Sources for Future Potable use and Their Estimated Desalinization Costs* (see 1.1.1 above)
- *Improving Thermodynamics and Economic Efficiencies of Desalination Plants* (not yet complete), Byard Wood and University of Nevada-Reno. Funded by USBR.
- *Integrating Membrane Treatment in Large Water Utilities: Investigating Treatment, Construction and Costs*, (not yet completed), Carollo Engineers. AWWARF contract #2876.
- *Maricopa Ground Water Treatment*, 1996, USBR, Denver, CO. \* (report #15)
- Role of MF Cake Composition & Stability in Desalination Efficiency, DRIP, Orange Co. WD.
- *Survey of U.S. Costs and Water Rates for Desalination and Membrane Softening Plants*, 1997, Leitner & Associates, Florida and Connecticut. \* (report #24)
- *Water Treatment Estimation Routine User Manual*, 1999, USBR, NIST.  
\* (report #43)

#### 1.4. Energy Considerations and Requirements

- *Reduced Energy Consumption Evaporator for Use in Desalting Impaired Waters*, 1994, Water Reuse Technology; Alamo, CA. \* (report #11)
- *VARI-RO™ 'Low Energy' Desalting for the San Diego Region*, 1995, Science Applications International, San Diego, CA. \* (report #4)

#### 1.5. Desalination Technology Research

- Advanced Water Treatment for Potable Reuse, DRIP, Sonoma Co. WA.
- Agricultural Drainage Water Reuse, DRIP, UC Riverside.
- Brackish Groundwater Desalination, DRIP, San Diego Co. WA.
- Colorado River Water Salinity Reduction, DRIP, Metropolitan.
- Compatibility of Ultraviolet Light Technology, DRIP, Metropolitan.
- Develop Salinity Reduction Technologies, DRIP, Orange Co. WD.
- Develop Salinity Reduction Technologies for Surface Water, DRIP, Metropolitan.
- Development of a Knowledge Base for Desalination Technology, DRIP, San Diego Co. WA.
- Development of Low Pressure Membrane Technology, DRIP, West Basin MWD.
- Monitoring of Ultraviolet Light Dosage, DRIP, Metropolitan.
- Optimization of Conventional Treatment, DRIP, Metropolitan.
- Salinity Removal Technologies for Surface Water Desalting, DRIP, Metropolitan.

- Salinity Removal Technologies for Municipal Wastewater Desalting, DRIP, Orange Co. WD.
- Salt Removal for Agricultural Drainage Water, DRIP, UC Riverside.
- Solids and Salinity Removal Technologies for Agricultural Drainage Water, DRIP, UC Riverside.
- Solids Removal Technologies for Municipal Wastewater Desalting, DRIP, Orange Co. WD.
- Solids Removal Technologies for Surface Water Desalting, DRIP, Metropolitan.
- Ultraviolet Light Dose & Hydrodynamic Characterization of UV Reactors, DRIP, Metropolitan.

#### 1.6. Desalination Facilities Research Studies / Pilot Projects

- *Build and Operate a Clathrate Desalination Pilot Plant*, 1998, Thermal Energy Storage, San Diego, CA. \* (report #31)
- *Clathrate Desalination Plant, Preliminary Research Study*, 1995, Thermal Energy Systems, San Diego, CA. \* (report #5)
- *Eastern Municipal Water District RO Treatment/Saline Vegetated Wetlands Pilot Study*, 1996, USBR, Denver, CO. \* (report #16)
- *Evaluation of the Port Hueneme Demonstration Plant - An Analysis of 1 MGD Reverse Osmosis, Nanofiltration, and Electrodialysis Reversal Plants Run Under Essentially Identical Conditions*, 2001, USBR. \* (report #65)
- *Preliminary Research Study for the Construction of a Pilot Cogeneration Desalination Plant in Southern California*, 1995, Supersystems, Irvine, CA. \* (report #7)
- *Research Opportunities at the Yuma Water Quality Improvement Center*, Summary Report of a Joint Reclamation/ADA Seminar Held 1/23/97 in Yuma AZ. \* (report #25)
- Scale-Up Issues for Microfiltration Systems, DRIP, Orange Co. WD.
- Scale-up Factors from Pilot to Full-scale Operation of Reverse Osmosis Units, DRIP, San Diego Co. Water Authority.
- *Seawater Desalination Pilot-Plant to Advance the State-of-the-Art by Optimization of Microfiltration/Ultrafiltration and Reverse Osmosis* (not yet complete), Paul Shoenberger and West Basin Municipal Water District. Funded by USBR.
- *VARI-RO™ Desalting Pilot Plant Advancement Project Testing and Evaluation*, 2001, Science Applications International, San Diego, CA. \* (report #62)
- *VARI-RO™ Direct Drive Engine Study (draft), Final Technical Report*, 1998, Science Applications International, San Diego, CA. \* (report #33)
- *VARI-RO™ 'Low Energy' Desalting Pilot Plant Testing and Evaluation, Final Technical Report*, 1998, Science Applications International, San Diego, CA. \* (report #30)
- *Wastewater Reclamation Pilot Study City of McAllen, Texas*, 1997, CH2M Hill, Tempe, AZ. \* (report #26)

## 2. Distribution Issues (getting water into supply system, involves supply agencies)

- *Water Quality Issues Related to Seawater Desalination*, (see under 1.1 above)

### 2.1. Disinfection

- Disinfection Alternatives for Surface Water, DRIP, Metropolitan WD.
- Disinfection Alternatives for Municipal Wastewater, DRIP, Orange Co. WD.
- *Integrated, Multi-Objective Membrane Systems for Control of Microbials and DBP Precursors*, (see 1.2 above).
- Scale-Up Issues for UV Disinfection with RO Desalination, DRIP, Metropolitan.
- *Water Resource Management Strategies for Compliance With Multiple Regulatory Requirements*, Economic and Engineering Services, Inc., AsRP, AWWARF contract #2733.

### 2.2. Corrosion, Blending and Stability

- *Case Studies of the Impacts of Treatment Changes on Biostability in Full Scale Distribution Systems*, 2000, Montgomery Watson, American Water Works Service Company, Lyonnaise des Eaux, and University of Central Florida. AWWARF publication #90816.
- *Required Treatment and Water Quality Criteria for Distribution System Blending of Treated Surface, Ground and Saline Sources*, (not yet completed), University of Central Florida. AWWARF contract #2702.
- *Water Quality Impacts from Blending Multiple Water Types*, 2001, Laboratory of the Government (U.K.) and Pipeline Development. AWWARF publication #90853.

## 3. Discharge and Environmental Effects (impacts on water supply and environmental effects, involves regulatory agencies)

- *Desalting as an Environmentally Friendly Water Treatment Process*, Summary Report of an ADA Seminar Held 9/11/94 in Palm Beach, FL. \* (report#13)
- Feasibility for Future Indirect Potable Reuse, DRIP, Santa Clara Valley WD.
- Tailored Municipal Wastewater Reclamation for Industrial Applications, DRIP, Santa Clara Valley WD.
- Using Tertiary Treated Water in a Large-Scale Streamflow Augmentation, DRIP, Santa Clara VWD.

### 3.1. Concentrate Management, Treatment and Disposal

- Biological Sulfate Reduction for Recovering RO Brine, DRIP, Metropolitan.
- Biological Sulfate Reduction for Recovering RO Brine – Pilot, DRIP, Metropolitan.
- *Brackish Groundwater Treatment and Concentrate Disposal for the Homestead Colonia El Paso, Texas*, 1999, University of Texas at El Paso. \* (report #32)

- Brine Minimization: Demonstration Scale Testing & Economic Feasibility, DRIP, Metropolitan Water District.
- Brine Treatment Technology for Large-Scale RO, DRIP, Metropolitan.
- *Communication Tools for RO/NF Concentrate Issues*, (not yet completed), Bureau of Reclamation. AWWARF contract #2916.
- *Concentrate Disposal Cost Worksheets*, Bureau of Reclamation.
- *Current Management of Membrane Plant Concentrate*, 2000, Clarkson University. AWWARF publication # 90813.
- *Development of a Brine Concentration Process Using Membrane Technology for High-Silica Brackish Water* (not yet completed), Anthony Tarquin and the University of Texas at El Paso. Funded by USBR.
- Evaluation of Brine Minimization for Surface Waters, DRIP, Metropolitan Water District and UCLA.
- *Evaluation of Economic and Reliable Methods of Brine Management*, 12/30/96, Stonewall County, Texas; Texas Water Develop Board contract. \*\*
- *Evaluation of Two Concentrate Disposal Alternatives for the Phoenix Metropolitan Area: Evaporation Ponds and Discharge to the Gulf of California*, 2000, USBR, Denver, CO, for the Sub-Regional Operating Group of the Arizona Municipal Water Users Association. \* (report # 54)
- Freeze-Thaw and Freeze Desalination of Brine Residuals, DRIP, Metropolitan.
- *Halophyte Crops and a Sand-Bed Solar Concentrator to Reduce and Recycle Industrial, Desalination and Agricultural Brines*, 1998, University of Arizona, Tucson, AZ and Texas A&M University, El Paso, TX. \* (report #35)
- *Membrane Concentrate Disposal: Practices and Regulation*, 2001, Mickley and Associates. Funded by Bureau of Reclamation. \* (report #69)
- Reverse Osmosis Desalination Brine Reduction via Tunable Biopolymers, DRIP, UC Riverside.
- *Systems Development for Environmental Impact Assessment of Concentrate Disposal* (not yet completed), Robert Doneker and Oregon Health and Science University. Funded by USBR.
- *Treatment of Concentrate and Backwash*, (not yet completed) Mickley and Associates. Funded by USBR.
- *Zero Waste Brine Management for Desalination Plant*, 2002, University of Texas at El Paso. \* (report #89)
- *Zero-Discharge Seawater Desalination: Integrating the Production of Fresh Water, Salt, Magnesium, and Bromine*, (not yet completed), Thomas Davis and the University of South Carolina. Funded by USBR.

## 3.2. Ocean Intake

### 3.2.1. Locating new pipelines

- Side Scan Sonar Survey (proposed, MWDOC).



- Underwater Reconnaissance (proposed, MWDOC).

#### 3.2.2. Entrainment and impingement of marine organisms

- Fish Survey (proposed, MWDOC).
- 316 (b) Equivalent Study (proposed, MWDOC).
- Oceanographic Field Investigations (proposed, MWDOC)

### 3.3. Ocean Outfall

#### 3.3.1. Locating new pipelines (see 3.2.1 above)

#### 3.3.2. Plume modeling

- Near-field modeling: CORMIX: Cornell Mixing Model (proposed, MWDOC).
- Far-field modeling: Princeton Ocean Model; Environmental Fluid Dynamics Code; Delft 3; Mike 3; HPA-3D.

#### 3.3.3. Toxicity testing

- Toxicity testing at Carlsbad.
- Tampa Bay studies (Lesser Antilles).

## 4. Alternative Technologies and Strategies

- *Application of Electret Technology to Low Cost Desalination*, 2002, University of Denver, CO. \* (report #73)
- *Demonstration of the Natural Freeze-Thaw Process for the Desalination of Water from the Devils Lake Chain to Provide Water for the City of Devils Lake*, 2002, B.C. Technologies, Laramie, WY and University of North Dakota, Grand Forks. \* (report #71)
- *Evaluation of the Natural Freeze-Thaw Process for the Desalination of Groundwater from the Dakota Aquifer to Provide Water for Grand Forks, North Dakota*, 2001, B.C. Technologies, Laramie, WY and Energy & Environmental Research Center, University of North Dakota, Grand Forks. \* (report #23)
- *Innovative Atmospheric Pressure Desalination*, 1999, Arizona State University; Tempe. \* (report #52).
- *Investigation of High Freezing Temperature, Zero Ozone, and Zero Global Warming Potential Clathrate Formers for Desalination*, 2000, Thermal Energy Storage, San Diego, CA. \* (report #59)
- *Novel Membrane and Device for Direct Contact Membrane Distillation-Based Desalination Process*, 2001, New Jersey Institute of Technology, Newark. \* (report #87)
- *Photovoltaic (PV) Reverse Osmosis Desalination System* (not yet completed), Sing-Foong Cheah and ITN Energy Systems. Funded by USBR.
- *Pilot Investigation of Slow Sand Filtration and Reverse Osmosis Treatment of Central Arizona Project Water*, 2002. USBR. \* (report #90)

- *Solar and Waste Heat Desalination by Membrane Distillation* (not yet completed), John Walton and University of Texas at El Paso. Funded by USBR.
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## NWRI Membrane Research and Articles

### Membrane Research and Development Programs

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#### **Analysis of Biocide/Biofilm Interactions by Attenuated Total Reflection Fourier Transform Infrared Spectrometry**

Harry F. Ridgway, Ph.D., Orange County Water District, Fountain Valley, CA  
Project No. MRDP 699-503-93

#### **Colloidal Fouling in Reverse Osmosis Membranes**

Menachem Elimelech, Ph.D., University of California, Los Angeles, CA  
Project No. MRDP 699-502-92

#### **Dean Vortex Instabilities for Reducing Concentration Polarization and Fouling and for Developing New Membrane Module Designs**

Georges Belfort, Ph.D., Rensselaer Polytechnic Institute, New York, NY  
Project No. MRDP 699-505-93

#### **Dean Vortex Instabilities for Tubular Membrane Module Design**

Georges Belfort, Ph.D., Rensselaer Polytechnic Institute, New York, NY  
Project No. MRDP 699-501-94

#### **Development and Testing of New Nanofiltration Membranes for Application to Water Treatment: An Integrated Polymer Chemistry/Engineering Approach**

Francis A. DiGiano, Ph.D., University of North Carolina  
Project No. MRDP 699-508-95

#### **Influence of Molecular Conditioning Films on Microbial Colonization of Synthetic Membranes Determined by Internal Reflection Spectrometry**

Kenneth P. Ishida, Ph.D., Orange County Water District, Fountain Valley, CA, Project No. MRDP 699-508-95

#### **Survey of U.S. Costs and Water Rates for Desalination and Membrane Softening Plants**

Gordon F. Leitner, Leitner & Associates, Inc., Boca Raton, FL  
Project No. MRDP 699-509-96

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# ***Water Quality Implications of Large-Scale Application of Seawater Desalination***

## **SCOPE OF WORK**

Task	Description
1	Investigate Water Quality Challenges for Desalination Applications for Potable Water <ul style="list-style-type: none"><li>1.1 Literature Review</li><li>1.2 Desalination Case Studies</li></ul>
2	Source Water Assessment for Desalination Applications <ul style="list-style-type: none"><li>2.1 Monitoring Plan for Alternative Sources of Seawater in the U.S.</li><li>2.2 Sampling and Analytical Quality Assurance</li><li>2.3 Assessment of Seawater Quality</li><li>2.4 Bench-scale Evaluation of Reverse Osmosis (RO) Permeate Quality of Seawater</li></ul>
3	Pilot Study Design and Facility Implementation <ul style="list-style-type: none"><li>3.1 Design of Pilot Testing Program<ul style="list-style-type: none"><li>• characterize water quality parameters that impact microfiltration pre-treatment</li><li>• test RO membrane performance</li><li>• optimize integrated (MF/RO) membrane system</li><li>• assess potential for formation of disinfection byproducts (DBPs)</li><li>• evaluate efficacy of controls for distribution system corrosion (Dr. Marc Edwards, Virginia Polytechnic Institute)</li><li>• characterize concentrate residuals</li><li>• assess taste and odor characteristics of permeate</li><li>• develop monitoring plan for each test phase that captures the important operations and water quality parameters in terms of the experimental goals</li></ul></li><li>3.2 Review Basis of Design and Design Documents</li><li>3.3 Facility Implementation and Startup</li></ul>
4	Conduct Pilot Testing Project <ul style="list-style-type: none"><li>4.1 Conduct Monitoring Project</li><li>4.2 Pilot Testing Sampling and Analytical Quality Assurance</li><li>4.3 Data Management Development and Implementation</li><li>4.4 Evaluation of Pilot Testing Results</li></ul>
5	Project Workshop for Team Collaboration
6	Final Project Report